Title:

Karst aquifer discharge response to rainfall interpreted as anomalous transport

Authors:

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General remarks:

The proposed methodology have a significant interest among the present challenges in karst hydrology for flow and transport modeling. The manuscript is of interest for the scientific community. Nonetheless, I found some important methodological aspect that, in my point of view, should be addressed before potential publication.

Specific comments to the paper:

Line 62: the role of the pore connection should be also mentioned, porosity is an important factor in flow and transport as well as the continuity between pores. This notion should appears in the introduction, as well as tortuosity, which then used in the proposed methodology.

Line 104: “well-defined spatial catchment” sounds unclear, are the boundaries well defined with the topography and/or geological setting?

Line 117 “ansatz” is a German word, this appears several time across the manuscript.

Line 117: “water parcels” the notation sounds unclear is it like “water bodies” between flow zone and dead zone or is it a quantity of water that should be considered as an analogy with an amount of particle ? This point can be clarified in the paragraph.

Line 123: “water parcels” and “tracer parcels” sounds unclear, a more detailed explanation might help the reader to understand how the analogy is done in the manuscript.

Fig 1. (c) and (d) does the volumetric discharge considers a constant concentration and does the concentration variation assumes a constant discharge ? In my point of view, discharge and concentration cannot be separated so the two might appears on the graph, then the final time series that the author are using will appears more clear to the reader. At some point, the present version bring some confusion with the widely used tracer BTC.

Line 172: “C(t) is reinterpreted as translated to a water volume” please clarify the underlying hypothesis to move from concentration curve to fluxes curve.

Fig 3. I don’t think we can consider the fit as satisfactorily. The data do not exhibit a normal distribution shape, also the fitted distribution provides negative distances. The fitted distribution should then at least be a truncated distribution to avoid negative values.

Fig 5. How is the curvature of the likelihood distribution fixed? Is it a working hypothesis or is it derived from somewhere else?

Line 283: 'optimization is achieved' How is the optimization performed? Which methodology/algorithm? I would recommend also to write "model parameter estimation" rather than "optimization".

Line 293: Why using NSE values that tends to favorize large values while the focus seems to be on tailing? Other performance criteria for model evaluation would be more suitable, or another option would be to compute NSE on a variable transformation such as 1/Q or squared_root(Q)

Table 1: Please add the min and max of the investigated parameter space for the model parameter estimation. Also, please give more information about how the optimized value is estimated (see one of the previous comment) + the estimated tortuosity appears pretty high compared with the literature (e.g. reference below) could you discuss a little on that ? Is it a realistic value for the catchment?

Jouves, J., Viseur, S., Arfib, B., Baudement, C., Camus, H., Collon, P., Guglielmi, Y., 2017. Speleogenesis, geometry, and topology of caves: A quantitative study of 3D karst conduits. Geomorphology 298, 86–106. https://doi.org/10.1016/j.geomorph.2017.09.019

Collon, P., Bernasconi, D., Vuilleumier, C., Renard, P., 2017. Statistical metrics for the characterization of karst network geometry and topology. Geomorphology 283, 122–142. https://doi.org/10.1016/j.geomorph.2017.01.034

Line 324: Is it correlation coefficient or correlation pic derived from cross correlation function analysis? What is the time lag considered for the correlation coefficient or what is the lag response obtained based on precipitation-discharge cross correlation function?

Line 328: This sentence is not useful. I recommend to delete.

Line 374: As previously mentioned in my comments, other performance criteria would be more suitable to evaluate the predictive performance of the model regarding high flow and low flow periods respectively. Computing NSE by removing the high value is not a suitable justification for the model improvement on low flow period. Indeed, by skipping the high discharge value to compute the NSE you are changing the benchmark of NSE (the mean of observed time series) so comparison of NSE is not straightforward in that case.

Line 377: Are there some evidence of piston effect with temperature and/or conductivity?

Fig 8. Is not very informative as "sensitivity analysis". Including a sensitivity analysis on the model parameter regarding the model performance would be much more informative. Among the model parameters which one are the more sensitive in the model?